STATE OF WISCONSIN

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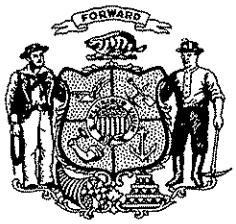

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JOINT COMMITTEE ON FINANCE

MEMORANDUM

To: Members
Joint Committee on Finance

From: Senator Mark Miller
Representative Mark Pocan

Date: November 18, 2009

Re: University of Wisconsin System Industrial and Economic Development Research Report

Attached is a report on Industrial and Economic Development Research from the University of Wisconsin System, pursuant to s. 36.25(25)(c), Stats.

Section 36.25(25)(c), Stats., requires the University of Wisconsin System to report biennially to the Joint Committee on Finance regarding projects funded as part of the industrial and economic development program in the previous fiscal biennium and the relationship of the funded projects to the state's economy.

This report is being provided for your information only. No action by the Committee is required. Please feel free to contact us if you have any questions.

Attachments

MM:MP:jm

UNIVERSITY OF WISCONSIN SYSTEM

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November 16, 2009

To: Senator Mark Miller, Co-Chair, Joint Committee on Finance
Representative Mark Pocan, Co-Chair, Joint Committee on Finance

From: Kevin P. Reilly, President

Subject: Industrial and Economic Development Research Report

Section 36.25(25) (c), Wis. Stats., requires the University of Wisconsin System to report biennially to the Joint Committee on Finance regarding projects funded as part of the industrial and economic development research program in the previous fiscal biennium and the relationship of the funded projects to the state's economy. The enclosed report is hereby submitted for your review.

If you require any additional information regarding the Industrial and Economic Development Research Report, please contact Kris Frederick, Office of Budget and Planning (608-262-8939 or kfrederick@uwsa.edu).

Enclosure

cc: UW Board of Regents
Rebecca Martin, Senior Vice President
Deborah Durcan, Vice President
Freda Harris, Associate Vice President
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Industrial and Economic Development Research Fund
2007-09 Biennial Report

The Industrial and Economic Development Research Fund (IEDRF) was established in 1987 to enhance the relationship between UW System institutional research and Wisconsin industrial practices in an effort to promote the state's economic growth. It has supported projects which have assisted a large number of Wisconsin enterprises. Many of these projects continue to improve the competitive position of Wisconsin business.

This report describes the activities supported by the IEDRF for the 2007-08 and 2008-09 fiscal years. The report is divided into three narrative sections and five appendices. The first narrative section details the Industrial and Economic Development Research Program (IEDR), which provides grants to faculty at UW-Madison. This program is administered by the UW-Madison Graduate School. The second section provides an overview of the Applied Research Program, administered by the UW System Office of Academic Affairs. These funds provide grants to faculty throughout the UW System. The final section describes the activities of the Center for Dairy Profitability, an on-going UW-Extension and UW-Madison project that addresses economic challenges to Wisconsin's dairy industry.

Both the IEDR program and the Applied Research Program provide grants which are competitively awarded. Researchers are encouraged to submit technically innovative proposals that are of interest to a broad economic sector and which will immediately benefit Wisconsin's industrial and economic development. All projects are selected based on a combination of scientific merit and the potential for technology transfer. Grant summaries are provided in the appropriate sections.

Four appendices are attached which list all grants, investigators, campus or department, and the amount funded by the IEDR and Applied Research programs. A final appendix notes extramural grants, awarded in support of the work done by the Center for Dairy Profitability.

A. Industrial and Economic Development Research (IEDR) program – UW-Madison Graduate School

The Graduate School administers the IEDR program for the University of Wisconsin-Madison. The IEDR program goals are to stimulate and enhance collaborations between the UW-Madison and Wisconsin firms and to promote economic development in the state. A panel of faculty members employs a competitive process to select technically innovative projects that benefit Wisconsin businesses from proposals submitted by university faculty and staff researchers. The panel also reviews each proposal for scientific and technical merit.

The IEDR program funded 17 projects ($710,959) in fiscal year 2007-2008 and 15 projects ($712,497) in fiscal year 2008-2009. Research objectives and findings for individual projects are summarized in this report. The following points are other noteworthy outcomes resulting from IEDR program research:

- Faculty indicated that IEDR funding has been important to demonstrate state and university commitment to translational research, to solidify research collaborations with companies, and to leverage awards into further funding opportunities. Corporate partners often provided additional funding and in-kind support in the form of materials, equipment, and staff time for IEDR projects valued in excess of $740,000. After the IEDR funding period ended, these collaborations often continued, some with ongoing financial support from the corporate partners.

- Data from IEDR projects allowed several faculty to apply for and receive large research grants directly from federal agencies, small research grants through non-profit agencies, and subcontracts with partnering companies. Grants received as a result of IEDR research totaled over $2.3 million. In addition several grants submitted during this past spring are still pending.

- IEDR research successes were instrumental in the federal government awarding Small Business Innovation Research grants to one of the company partners, Small Business Technology Transfer grants to two other company partners, and venture capital money and a USDA National Research Initiative Grant to a fourth company partner.

- As a result of IEDR research, some collaborating companies plan to hire additional staff, will achieve cost savings, or are in better positions to market their products.

- Faculty submitted at least 12 invention disclosures in 2007-08 and 5 invention disclosures in 2008-09 to the Wisconsin Alumni Research Foundation. WARF has applied for at least 10 patents from these projects so far, and additional patent applications are likely.

- Postdoctoral fellows, Ph.D. candidates, Masters degree candidates, and undergraduate students worked on these projects. Many of these students received training for hi-tech jobs. In fact, one faculty member reported that two graduate students were hired following graduation as a direct result of their participation in the IEDR project. Other faculty stated that students in the courses they teach benefitted from technological advances made through IEDR research and from equipment obtained to conduct IEDR projects.

- Researchers have published 13 research papers in peer-reviewed journals and conference proceedings, and more than 30 papers are either submitted, in progress or planned.

Appendices A and B contain tables that identify the principal investigators, university departments, and the amounts of each project awarded.

IEDR Research Projects, Fiscal Year 2007-2008
University of Wisconsin-Madison

See Appendix A for a list of investigators, departments, and amounts of the awards.

1. Towards Cost Effective Design and Management of City-Wide Wireless Grids

The goal of this project has been to design a software toolkit that provides cost effective design and management of an emerging wireless-based broadband technology typically referred to as wireless mesh networks (WMNs). The research team has built a software toolkit that significantly improves on the state-of-the-art. Our tools have been applied in monitoring the MadCity Broadband, our cooperating company, which has a wireless mesh network deployed in Madison. Managing a network of this size (more than 250 pole-mounted Mesh APs) and scale (covering more than 10 square miles) is challenging, and our tools facilitate better manageability of these networks. All software and results developed in this effort are being made available for public use, as is common practice for many research efforts in software development. A technical paper was published in a premier conference in the field, the Internet Measurement Conference 2008. The project has also drawn the attention of various wireless vendors, especially Cisco Systems, which is the vendor of a significant part of MadCity Broadband's wireless hardware. Cisco has subsequently donated about $180,000 in support of these research efforts, and has also provided some of their state-of-the-art equipment for additional evaluation of various research prototypes. Two students involved in this project have graduated and have joined Cisco Systems as

engineers. Finally, information gained from this project has been incorporated into the Introduction to Computer Networking (CS640) course.

2. HTS Microfluidics for Cardiac Screening

The goal of this project was to develop a microchannel based assay for cardiac drug screening using hERG cell (potassium channel overexpressed HEK cells). The researchers demonstrated the ability to seed cells evenly into microchannels and culture cells successfully in microchannels. Cell characterizations (proliferation, protein expression, and electrophysiology properties) demonstrate that microchannel cell culture platform is comparable to canonical cell culture platform for hERG cells. Potentially, hERG microchannel culture can be used in high throughput drug screening. The data produced will be used for a joint Beebe/Kamp/January NIH proposal to continue and expand the project. This proposal is currently pending funding. The cooperating companies were CDI and Bellbrook Labs.

3. Device for MRI-guided Biopsy and Therapy of Breast Cancer

This work developed an MR image-guided biopsy and therapy system for localizing breast lesions with 3D radial access. The device is combined with a novel receiver antenna ("RF-coil") for detecting MR signal from the breast that improves the detected signal in MR images of the breast. The RF-coil and biopsy system rotates 360 degrees around the breast to allow medial access and minimize insertion depth to suspected breast lesions. The device was shown to work well in test studies using gel phantoms and animal breast tissues. The needle tip was in contact with the targeted lesion in 89% (25/28) of all the trials and 100% (6/6) of the trials with targeted lesions >6 mm (the largest lesion size tested was 8 mm). The receiver demonstrated improved signal to noise ratio over existing commercial systems. Tools for accomplishing breast tissue immobilization with circumferential compression were demonstrated and showed minimal distortion of the breast tissue. The project has resulted in 3 patent disclosures to the Wisconsin Alumni Research Foundation (WARF), one paper published in the journal *Medical Physics*, and a $1M grant from NIH. The cooperating company was Marvel Medtech.

4. Foot Force Direction Training for Rehabilitation and Fitness

The objective of this research was to develop an electromechanical training environment to restore walking ability after a person has a stroke. The proposed system would retrain human foot force direction through seated pedaling exercises. The scientists successfully developed the seated training system as proposed, and in addition then developed a similar system for walking. With the system, the team completed an empirical study of human walking that demonstrates for the first time how humans share a control strategy across seated and walking tasks. This finding implies that the stroke-induced directional control deficit we previously characterized in seated tasks also plays a critical role in walking difficulties. Two patent disclosures have been made as a result of this work, a manuscript has been submitted for publication, and the resulting treadmill will be used on a Kinesiology course titled "Biomechanics of Human Movement." The cooperating company was Saris Cycling Group.

5. Carbon Nanofiber Supercapacitors and Supercapacitor-Battery Hybrid Devices

The goal of this project was to explore the potential development of a type of energy storage device called a "supercapacitor" that would have improved properties, leveraging UW technology developments in nano-carbon electrode and organosilicon compounds. Because organosilicon compounds are much less flammable than the materials used in existing supercapacitors but require different types of electrodes, the goal was to identify whether improved, safer, energy storage devices could be developed, and to identify the likely limits of performance. The research team succeeded in conducting essential tests of the conductivity and capacitance properties of the organosilicon electrolytes, constructed prototype capacitors and demonstrated the effectiveness of coupling nanostructured carbons with organosilicon electrolytes for ultracapacitors. This work was crucial in demonstrating the performance characteristics of the electrolytes alone and in combination with several types of nanostructured carbon electrodes. One patent has been filed as a result of this work as well as one publication, with more in the works. The cooperating company was Silatronix. Based in part on the results from this project, Silatronix successfully applied for

a $500,000 NSF-SBIR Phase II grant. The Principal Investigator of this project is eligible for a 1:1 match as a result of this grant.

6. Development of Biophysically-Based Fluids for People with Swallowing Disorders
Our primary objective was to develop commercial fluids designed for effective and enjoyable use by people who suffer from swallowing disorders (dysphagia). The preliminary work showed that the current commercial thickened beverages available for individuals with dysphagia lacked sufficient flavor and did not match the viscosity properties of the standard fluids used for diagnosis. Several thickened beverage prototypes were developed, in conjunction with the Galloway Company (Neenah, WI), for evaluation with both healthy and dysphagic subjects. Although the results are still being analyzed, these drinks are better liked and more closely match the standard diagnostic fluids than commercial thickened beverages. Based on the IEDR results, the research team was successful at garnering a three-year grant from the USDA National Research Initiative ($680,000) to continue work in this area.

7. Enabling Atom Probe Tomography using Silicon Nanwire Arrays as Microtips
The objectives of this research was to use chemical synthesis to prepare arrays of vertical silicon nanowires ("nanotips") and explore them to prepare specimens for LEAP nanostructural analysis and synthesize novel alloy nanowires of FexCo1-xSi and use them as the "benchmark" samples to demonstrate the remarkable capacity of LEAP instruments in analyzing nanomaterials samples. The research team has successfully prepared alloy nanowires of FexCo1-xSi and used LEAP analysis on these "benchmark" samples to show that there are truly atomically homogenous. In doing so, the remarkable capacity of LEAP is convincingly demonstrated. They have also developed the techniques to prepare arrays of vertical silicon microposts with nanometer sized tips to be used as sample mounts for LEAP analysis. One article has been published in *Nano Letters* and 4 students working on the project have received awards in part due to their work on the project. The cooperating company was Imago Scientific Instruments Corp.

8. Focused RF Heating Mechanism for Thermoacoustic Tomography
Thermoacoustic tomography (TAT) involves rapid cyclical heating and cooling of tissue using high frequency electromagnetic waves and then reconstructing images of the target anatomy using the acoustic pressure waves generated by the resultant expansion and contraction of tissue. The objective of the proposed research was to develop techniques to achieve focused RF heating of arbitrary target regions for TAT using several closely placed transmitting antennas. High power RF current sources that are capable of driving up to 8 amperes of current into the transmitting antennas have been developed. Excellent suppression of induced current due to cross-talk with neighboring antennas has been demonstrated. Induced current suppression is essential for independent control of antenna currents, enabling focused RF heating. The project has resulted in one publication. The cooperating company was General Electric Healthcare.

9. Using Functional MRI to Study Balance Control in the Human Brain
The 4 major research objectives of this pilot study were to: 1) assess the clinical efficacy of a new form of neurorehabilitation technology that we have developed, called cranial-nerve non-invasive neuromodulation (CN-NINM) by performing behavioral tests before, during and after training with the device; 2) develop a therapeutic training regimen for application of NINM to specific neurological symptoms; 3) develop and test new fMRI signal processing methods to improve image resolution specifically for the human brainstem and cerebellum; and 4) use the improved fMR imaging technique to investigate possible functional changes in these neural structures for evidence of induced brain plasticity and neurorehabilitation in response to CN-NINM. The team of scientists developed a new cranial nerve non-invasive neuromodulation (CN-NINM) device that excites and entrains neural activity in the brain, and tested its efficacy with 5 patients having moderate or severe balance, gait, and visual tracking deficits. All patients exhibited improved performance on all functional measures of postural and gait behavior as a result of NINM training, and patient scores in self-assessments of dizziness and mobility also uniformly

improved. The new fMR image signal processing techniques we developed afforded improved resolution of the brainstem and cerebellum, allowing observation of functional changes in activity in the areas that correspond to the improvements in the sensory-motor behavioral measures. These images provide the first evidence of how and where CN-NINM is apparently changing brain function. Three patents have been filed or in the process of being filed, three peer-reviewed journal articles are planned, and a small grant over $50,000 was received as a result of this research. The cooperating company was WiCab, although this relationship ended early when the scientist at WiCab working with this project left the company shortly after the grant began.

10. Durable Fiber Reinforced Polymer Connections for Precast Concrete Structures

The goal of this research was to develop and test alternative methods for connecting precast concrete structural members with non-metallic fiber reinforced polymer (FRP) components. Durable and non-corrosive FRP connection details were developed to be efficient and economical alternatives to current steel precast connection methods. Alternative connections were examined under two broad criteria: economic viability, and strength and durability performance. Two types of connections were examined: splices of reinforcing bars and connections between flanges of double-Tees used as floor members in parking garages. Spliced FRP rebar specimens were tested in tension until failure. Successful connections were obtained and the method is in the process of WARF patenting. FRP connection alternatives designed to resist shear forces between the flanges of typical precast double-T beams did not perform to the desired strength requirements. Improved connection methods using corrosion-resistant FRP materials were recommended for future investigation. The results of this research project have included one patent and a paper submitted to the American Composites Manufacturers Association Composites and Ploycon conference. The cooperating company was Spancrete Inc.

11. Recombinant Vaccines Against Avian Influenza Viruses

Our aim was to design and produce a safe vaccine that will protect mammals (e.g., laboratory mice, humans, cats) and birds (e.g. poultry) against highly pathogenic avian influenza (HPAI). We constructed several recombinant poxviruses containing the hemagglutinin (HA) gene from an HPAI isolate, along with an expression cassette designed to increase its expression. Raccoonpox virus-HA was tested in mice and produced a strong antibody response protecting them against highly pathogenic avian influenza. Subsequently groups of two-week-old chicks received RCN-HA by intramuscular, intradermal (wing-web stab), oral, and oculonasal routes. No illness or gross lesions were observed, other than a vaccination site lesion in the wing-web vaccinated chicks, indicating that RCNV is safe in juvenile chickens. For biosafety reasons, chicks were not challenged with HPAI. Compared with the control vaccine (inactivated Vietnam/1203 avian influenza virus plus alum adjuvant), RCN-HA administered by the intramuscular, wing-web, and oral routes produced higher neutralizing titers against a heterologous low-pathogenic H5N2 virus. The immunogenicity of RCN-HA in mammals and birds, and by multiple routes of administration, would be advantageous for mass vaccination in the case of an HPAI outbreak. This vaccine could have significant impact in protecting domestic poultry and wild bird populations against HPAI. The results from this research have also provided the basis for collaborations with our cooperating company to develop poxvirus-based vaccines that can protect humans against HPAI. We will use the results of this research to seek additional funding to test this vaccine in wild birds and other susceptible animals to HPAI. Several manuscripts as planned as a result of this project. The cooperating company was Inviragen LLC.

12. Evaluation and Improvement of Novel Traps for Mosquitoes and Other Insects

The objective of this research was to the best practice for consumers in expenditures of mosquito-control dollars. The research team tested whether human landing rates were reduced under either of two conditions: 1) deployment of a Mosquito Magnet trap within a yard; or 2) deployment of the SC Johnson

OFF lantern on a patio. The two practices are based on different principles. The Mosquito Magnet costs from $200-$1,000. The SC Johnson OFF lantern costs about $15. A third trap type, the DYNATRAP, was initially included in these studies, but it was quickly discovered that no carbon dioxide is released by these devices (contrary to the company's marketing materials). The researchers carried out human landing catches over two seasons (2007 and early 2008) and compared the number of mosquitoes that landed on human volunteers in yards or patios protected by one of these devices with control yards that were unprotected. The team monitored mosquito activity in each yard with a simple light trap, to verify that intensity of host seeking was approximately equal in both control and test sites. They found that the MM did not reduce the number of landings, although it did trap thousands of mosquitoes. The lanterns did reduce landing rates, except when the mosquito populations were high. The results of this work are in preparation for a manuscript. In addition, the research team put together a website http://www.entomology.wisc.edu/mosquitosite/ that was visited by more than 1,500 times during the two weeks of publicity for the site in August 2008. The cooperating company was DYNASEAL, although the relationship was terminated after the discovery regarding DYNATRAP and the lack of carbon dioxide released.

13. SPR Compatible Carbon Thin Films for Microarray Fabrication and Analysis

The research group had recently developed a lamellar substrate in which a thin layer of amorphous carbon is applied to a metal-coated substrate (carbon-on-metal substrate). The carbon overlayer provides the chemical robustness needed to support in-situ light-directed oligonucleotide synthesis while the metal underlayer allows the substrate to support surface plasmons, permitting binding events on the surface to be monitored with surface plasmon resonance (SPR) detection methods. The objectives of this proposal were to optimize the carbon-on-metal substrates to monitor the interactions of various biomolecules (DNA, RNA, and proteins) to oligonucleotide arrays in a label-free manner via SPR. In the past year the research team has optimized the carbon-on-metal substrates to reproducibly support *in-situ* oligonucleotide array synthesis and provide the maximal SPR sensitivity by modulating the thickness of the carbon overlayer as well as the metal (gold, silver, copper) underlayer. Several biological model systems have been developed to monitor DNA-DNA, DNA-RNA, and DNA-protein interactions with SPR imaging methods on the carbon-on-metal substrates. The stability of the carbon-on-metal substrates are far superior to those currently used in *in-situ* molecule synthesis and have prompted us to explore these substrates as possible supports for small molecule library synthesis. This work has led to a collaboration, as well as a 2-year NSF grant ($150,000 per year), with professor Helen Blackwell (UW-Madison Chemistry) to implement our carbon-on-metal substrates in studying the bacterial quorum sensing small molecule libraries developed in her lab. In addition this work has generated one patent that has been licensed, one additional disclosure, four published papers and another paper in progress. The cooperating company was GWC Technologies.

14. Novel Tools for Atomic Resolution Nanoscale Analysis: Combined Atomistic Modeling and Atom Probe Methods

The objective of this study was to develop an automated platform for attaching sugars to small molecule and peptide-based drugs. The sugar attachment chemistry (referred to as 'neoglycorandomization') to be automated was developed in the Thorson lab at UW. The proposed prototype 'glycolator' was designed to integrate the Thorson neoglycorandomization chemistry and existing automation technology of the local collaborative partner of this IEDR effort (Gilson, Inc.). The development of the 'glycolator' was also anticipated to advance the CarboConnectTM platform – a technology platform based upon the Thorson chemistry which was exclusively licensed by the local pharmaceutical start-up company Centrose. The Centrose CarboConnect platform enables the ability to enhance drug properties via sugar modifications. Most notably, this pilot study was successful in that it demonstrated the successful automation of the neoglycorandomization chemistry. Specifically, the study revealed that the Gilson GX-271 ASPECTM could be suitably adapted to accommodate the Thorson neoglycorandomization chemistry and that automation could improve the throughput of library synthesis. However, the study also revealed that the corresponding Gilson-based 'glycolator' was unlikely to compete against the

capabilities of existing, more expensive commercially available automated synthesis platforms (e.g. the Chemspeed ASW2000 workstation, the price of which is ~10-fold of the cost for the glycolator prototype hardware). Finally, the compound library synthesized in this study contained ~50 derivatives of the anticancer drug etoposide, two of which were recently found to be more active than the parent drug in certain cancer cell lines. As a result of this study, one disclosure was made to WARF and two papers are in progress. The cooperating companies were Gilson, Inc., and Centrose.

15. Development of a Nanomechanical Method Characterizing Single Cell Adhesion

Quantifying the strength of cell-matrix adhesion is crucial in the development of engineered implantable biomaterials and tissue scaffolds, as well as understanding a range of fundamental physiological and disease processes. Existing techniques for characterizing the mechanical strength of cell adhesion are either simple and only provide a relatively coarse measure of the strength of adhesion or are technically intensive and complicated and, as a result, have not been widely adopted by life science researchers. The objective of this IEDR project was to develop a new microfluidic-based adhesion assay that allows for simple, quantitative cell adhesion strength measurements to be performed in biology, medical, and pharmaceutical research labs. During the course of this project, a microfluidic adhesion strength assay was developed and experimentally demonstrated. Furthermore, an adhesion assay, which combines microfluidics and piezoelectric positioning technology, that allows for testing of cells cultured in a diverse range of environments has been designed and evaluated. The research completed in this IEDR project has the potential to allow nPoint, Inc., the cooperating Wisconsin company, to develop a new product and enter a new market. The work has also resulted in an invention disclosure to WARF and has provided a firm set of initial results that establish the basis for future joint proposals from the University of Wisconsin and nPoint, Inc., to federal research agencies. In addition a manuscript has been submitted regarding this work. The research that was initiated in this project is ongoing and the team is currently working to further refine and characterize the assay that has been developed.

16. Multi-Mode MR Intravascular Probes with RF Ablation Capacity

Atrial fibrillation (AF) is the most common adult cardiac tachyarrhythmia affecting more than 2,200,000 people in the US. Surgery is less desirable because it is invasive, risks morbidity and mortality, and requires long recovery. Minimally invasive, catheter-based radiofrequency (RF) ablation approach guided by X-ray fluoroscopy (XRF) with adjunctive electro-anatomic/mechanical mapping (EMM) is challenging and time-consuming due to poor soft-tissue contrast and poor depth perception. The objective of the proposed research was to design, develop, and validate novel multi-mode intravascular Magnetic Resonance (MR) probes with tracking, imaging, and RF ablation capabilities to allow MRI-guided catheter-based pulmonary vein isolation (PVI) procedures to treat AF. 8 F catheters with unipolar and bipolar RF Ablation tips have been developed and tested in parallel with tip-tracking and imaging capabilities. Advantages and disadvantages of both bipolar and unipolar designs have been demonstrated. This research may be used by GE Healthcare, our cooperating company to demonstrate the potential of an alternative low-cost MRI-guided therapeutic technique to treat AF especially, therefore leading to selling more MRI systems specifically to perform minimally-invasive therapeutic interventions. The impact on Wisconsin's economy is expected to be significant in terms of job creation, investment, and overall improvement in healthcare. The researchers plan to aggressively continue the development of catheters with RF ablation, tracking, and imaging capabilities for MRI-guided therapeutic interventions because results obtained from this project and another related project have helped us successfully compete for a 4-year $1.5 million-dollar R01 federal funding to further improve and bring this new technology into clinical translation. In addition, two disclosures with WARF have been made, and two to three papers are in progress.

17. Microfluidic Virus Infection Assays

The lab group sought to develop a method to detect and quantify infections of respiratory syncytial virus (RSV), a common viral infection in children less than 2 years of age, using the to test the susceptibility of virus infections to treatments by anti-viral drugs. They modified our strategy to develop tests for two

viruses, vesicular stomatitis virus (VSV) and influenza A virus, as alternatives to RSV. The VSV causes symptoms like foot-and mouth disease in livestock, so its characterization has relevance to agricultural interests. Influenza A virus has the potential to cause a pandemic in humans, particular H5N1 and related strains, so advances in drug tests for influenza A have potential for better targeted treatments of patients. We were able to show the feasibility of a higher sensitivity drug susceptibility assay for VSV and we have preliminary results that suggest the feasibility of the assay for influenza A virus. In the course of developing our most recent results we have initiated a collaboration with Bellbrook Labs (www.bellbrooklabs.com), a Madison, Wisconsin company that is providing us with unique microchannel systems for testing our approach. Moreover, in collaboration with Bellbrook Labs we were successful in leveraging the results from our IEDR project to obtain a two-year $600,000 Small Business Technology Transfer (STTR) grant from the National Institute of Allergy and Infectious Diseases (NIAID) of the National Institutes of Health (NIH). In addition, one disclosure has been made to WARF.

IEDR Research Projects, Fiscal Year 2008-2009
University of Wisconsin-Madison

See Appendix B for a list of investigators, departments, and amounts of the awards.

1. Application of Cognate Site Identifier Arrays to Drug Target-DNA Interactions
The report for this program was not submitted by the deadline for inclusion in this summary. Questions regarding this program can be directed to the principal investigator, Aseem Ansari, at (608) 265-4690 or ansari@bichem.wisc.edu.

2. High-Efficiency Mid-Infrared Semiconductor Lasers
The primary objective was to improve the efficiency of semiconductor lasers emitting in the midinfrared (IR) by significantly reducing the temperature dependence of their electro-optical characteristics by comparison to those of conventional mid-IR devices. We employed our WARF-patented concept for high-efficiency, mid-IR emitting semiconductor lasers: deep-well quantum-cascade (QC) lasers. As a result, injected-carrier losses have been suppressed and subsequently the electro-optical characteristics (e.g., the threshold current) vary with temperature 2.5 times *slower* in than conventional QC lasers, over the same temperature range: 20-90 oC. The cooperating company, Intraband LLC of Madison, is now in a position to develop products much superior in performance that those currently available commercially. Part of the new products will benefit the plastic-packaging industry and in turn Wisconsin's economy since, in terms of shipments (in dollars), Wisconsin's national rank is #1 in plastic film packaging. The primary future goal for this work is to develop the necessary device packaging for turning the developed mid-IR lasers into commercial products. The project has resulted in two patents, one disclosure, three published papers and a NSF funded project of $139,000.

3. Impact of Vitamin D Analogs on Experimental Colon Cancer in Rats
The research objective was to employ rodent models for familial colon cancer to test whether two new Vitamin D analogs developed by Deltanoid Pharmaceuticals prevent the formation or inhibit the growth of early colonic cancers. These studies were compared with the reported association in humans between high levels of Vitamin D metabolites and decreased incidence of advanced colon cancer. Our pilot investigations have detected no strong protective effect with subtoxic treatments by either Deltanoid analog, in both the rat and the mouse models. Supplements of the natural Vitamin D metabolite also have shown no detectable protective effect in pilot studies, even when combined with the known chemoprotective agent aspirin. The impact of these studies on the Wisconsin economy emerges with the establishment in this study of facile methods for the assessment of chemoprotective effects on early colon cancer. These established methods now provide the basis for federal research grant proposals emerging from the DoveLab and its collaborators at UW as well as a paper in progress. The future development of these studies rests on two factors: the development of a strong collegial spirit between the investigators

associated with the DoveLab and the Deltanoid team of Hector DeLuca and Lori Plum; and the recent development in the DoveLab of derivatives of the two rodent models that show frequent progression to advanced colon cancer. The investigation of the association of high levels of Vitamin D metabolites with lower incidence of advanced colon cancer in humans can now be focused on the progressed stages of the disease.

4. Development of Multiphoton Flow Cytometry for High Throughput Studies

Flow cytometers are well-established research and clinical instruments that can provide rapid, quantifiable, and verifiable data on single cell phenotype and differentiation state. However these commercial flow cytometers have significant size and depth limitations that have restricted their ability to characterize multicell entities, including stem cell aggregates and pancreatic islets. The research team proposed to develop a large particle fluidic path and a corresponding data acquisition system that will couple the deep sectioning benefits and multicell resolution of a multiphoton microscope with the high throughput and quantitative benefits of flow cytometry. They have developed a prototype multiphoton fluorescence excitation flow instrument (MPFC) that can be used to accurately probe cells deep in the interior of multicell aggregates or tissue constructs in an enhanced-throughput manner and excite endogenous fluorophores of cells as intrinsic biomarkers, thereby avoiding the invasive application of exogenous fluorescent labels. In addition, the researchers have demonstrated that this first generation MPFC system has appropriate speed of image capture and high accuracy of image capture and measured fluorescence intensity, including intrinsic fluorescence intensity of NADH. This novel instrument has the ability to enable rapid characterization of stem cells and corresponding aggregates in a noninvasive manner and could dramatically transform the manner in which stem cells are studied in the laboratory and utilized in the clinic. This technology could also be applied to other cellular systems where rapid non-invasive characterization is needed. This has great potential to leverage the optical strengths of our commercial partner Prairie Technologies, and open up a new market for them. They have characterized the functionality of the MPFC and its applicability to flow analysis of cellular aggregates. The biomedical and clinical application of the MPFC system will be significantly enhanced by the added capacity to sort cells and multicellular entities based on optical properties discerned by the system. Future efforts are focused developed automated sorting for the MPFC. This project has resulted in one disclosure to WARF, two papers in progress and two grant applications to NIH that are pending.

5. Enrichment of Phosphopeptides using Nanomaterials for MS-Based Proteomics

The research objectives of this project were two-fold: synthesize nanostructured materials to enrich the low abundant phosphopeptides (digested from protein mixture) for bottom-up proteomics, and design and synthesize the nanomaterials for the enrichment of phosphoproteins for top-down proteomics. The team of scientists has successfully synthesized mesoporous metal oxide nanomaterials for simple and effective enrichment of phosphopeptides from tryptic digests of complex protein mixtures with high specificity allowing comprehensive mass spectrometry characterization of the phosphopeptides. They have also developed multivalent superparamagnetic nanoparticles with phosphate binding moieties displayed on the surface and demonstrate its potential for enrichment of phosphoproteins for topdown proteomics. The research results give their industry collaborator, Promega (Madison, WI) a new technological platform to provide to potential customers interested in enriching phosphopeptides for a proteomics application. Promega is now evaluating the materials to determine their potential for future marketing. If the mesoporous metal oxide nanomaterials that were developed are commercially viable, these can be made and sold by Promega as consumable products to be used for phosphopeptide enrichment, which will increase income for the industry partner and possible creation of jobs in Wisconsin. The research team is now applying the mesoporous metal oxide nanomaterials for the enrichment of phosphopeptides from real biological samples (i.e. human heart tissues) and assisting Promega in the commercialization of this technology. This project has resulted in one published paper as well as one in progress. In addition, two federal grant applications have been submitted and are currently pending.

6. Dual-Modality Radiation Therapy

External beam radiation therapy for cancer has become more conformal, but it still has the downfall of delivering a significant dose to normal structures. On the other hand, internal radiation therapy, by means of internal emitters or brachytherapy, can potentially avoid normal tissue better, but the dose distribution is less uniform within the tumor. Investigation and improvement of the combined external and internal radiation therapy (synergetic endo-exo radiotherapy) was the main goal of this proposal. The research team has developed tools that can perform a combined external and internal treatment planning for radiotherapy. They have shown feasibility of a combined therapy. Through the research, the team has identified certain limitations (e.g., achieving homogeneity), which warrant further investigation. This research has the potential to expand the application of technologies from Tomotherapy, Cellectar, and Philips which would lead to increased sales. Collaborations amongst these companies would also necessitate hiring experts with interdisciplinary knowledge and thus increasing jobs. The scientists are planning to systematically investigate classes of internal therapies that could be successfully combined with external therapy. They are also planning to perform dosimetric evaluation on a pair of non-human primates with colon cancer. This project has resulted in one disclosure and an image produced as part of this project was awarded *Inveon Image of the Year - Winner* by Siemens Healthcare in 2008.

7. Develop Novel Micro-Arc Plasma Tool for Localized Surface Functionalization

This research project had several objectives. The first was to develop an original atmospheric-pressure, non-equilibrium (APNE), hybrid plasma tool (micro-arc discharge) that is coupled with a precision positioning and fluid dispenser system developed by SonoPlot, Inc., and related technologies. The second objective was to test the plasma-enhanced, localized surface functionalization and etching of plasmadeposited, perfluorinated (Teflon-like), thin macromolecular layers. During the research period the following tasks were accomplished: 1) Low–pressure, plasma-enhanced deposition of Teflon-like layers using C-PAM/Mat. Sci. & Eng. Technology licensed by SonoPlot; 2) Development of a specialized power supply for the generation of microdischarges; 3) Surface-etching/functionalization of plasma-polymer layers; 4) Analysis of plasma-generated surface modifications; and 5) Evaluation of reliability of APNE/fluid dispenser system. SonoPlot, Inc., has a significant interest in the outcome of this research because the plasma tool to be developed in the proposed project will be a significant addition to the GIX Microplotter that SonoPlot currently manufactures and sells, enabling very attractive novel research and application avenues in the biological and microelectronics areas. Biological research could produce microarrays on novel substrates, including TEFLON®, with superior performance and reduced cost. In the field of microelectronics, the hybrid tool could be used as an etcher to carve out 3D structures, such as MEMS with simultaneous functionalization. The collaboration will continue in the future between Mat. Sci. & Eng. / C-PAM and SonoPlot and work on addressing and eliminating the electromagnetic interference between the plasma tool and fluid dispenser system, during the plasma-enhanced operations, and in the area of various surface functionalization procedures. This project also produced an additional invention disclosure to WARF.

8. Development of a Universal Anode for Water Heaters

Steel corrosion is often reduced through the use of protective anodes, which oxidize and dissolve in place of the steel. A popular class of protective anodes are based on Al-Sn, although the limited solubility of Sn in these alloys is thought to reduce their effectiveness. The objective of this research is to understand the mechanism by which ternary dopants in Al-Sn alloys can alter Sn solubility. By understanding these mechanisms we hope to rationally design new Al anodes with greater ability to protect against corrosion. The research team performed a literature review and extracted and organized Al alloy compositions and anode corrosion potential data for easy data mining. They combined atomic simulation methods and thermodynamic modeling to demonstrate that simple lattice expansion, which is often assumed to be the dominant mechanism for enhancing Sn solubility, is inadequate to explain changes in Sn solubility energetics. A.O. Smith, their commercial partner in this work, estimated that it could save about $800,000 per year by creating more efficient and universal anodes for their water heaters. These anodes would last longer and a single model could be used in a wide range of water environments. The present research is intended to increase understanding of Al anode alloy thermodynamics to allow directed

development of efficient universal anodes. The future goal of this work is to assess quantitatively the affect of four key alloying elements (Ga, Zr, In, Bi) on Sn solubility in Al. This work is being continued under addition funding from A.O. Smith. There is also one paper in progress on the results of this project.

9. Characterization of the Morphological, Mechanical and Biological Properties of Seeded Bone Scaffolds

The primary research objective was to characterize the physical characteristics of tri calcium phosphate (TCP) bone scaffolds fabricated by Phillips Plastics Corporation, Prescott, WI (Phillips). The bulk stiffness was determined using quasi-static and dynamic compression testing, micro computed tomography (μCT) scanning and micro finite element analysis (μFEA). The secondary objective was to delineate the biological response of bone scaffolds, seeded with bone cells, to load. The team of scientists found, of the three types of scaffold that were tested, set "A" was the least stiff and sets "B" and "C" were the stiffest. All of the sets had a mean stiffness on the higher end of trabecular bone stiffness (0.628 to 28.3 N/μm for a 10 mm diameter, 5 mm height core) and even beyond this range, for sets "B" and "C." The biological and physical consequences of this high stiffness are not yet determined and cannot be inferred from this study alone. Additionally, it was found that the scaffold stiffness was reduced (24.7%, 27.7% and 10.8%) when tested wet at body temperature in comparison to scaffolds tested in air at room temperature. As stated in the Phillips news release, orthopedic conditions affect upwards of 75 million Americans annually, making it one of the largest and rapidly growing sectors of U.S. medicine. According to industry analysts, the specific stem cell market for orthopedic applications could exceed $3 billion within the next 10 years, from less than $100 million today. "As the U.S. population ages and individuals become more active throughout their lives, the use of orthobiologics will be a key part of many future orthopedic treatment paradigms," said Robert Cervenka, founder and CEO of Phillips. The future goal for this work is to complete the secondary objective of the study, that is, to delineate the biological response of bone scaffolds, seeded with bone cells, to load. The project has one paper in progress.

10. Simple and Affordable Human Health Monitor based on a New Laser Technology

The goal of this project was to develop a simple laser-based sensor for measuring the isotopic abundance of carbon dioxide in the human breath. Such a sensor would find widespread commercial application, most notably in hospital intensive care units (ICUs) to detect the onset of blood infection. This project was successful. The research team designed and assembled a sensor for measuring $^{13}CO_2$ concentration and showed that the noise level is sufficient to detect the small changes associated with blood infection in humans. The prototype sensor will directly benefit the cooperating company, Isomark in Madison, WI. Much more significant, however, will be the long-term effects kicked-off by this research, as the team continues to fund the development of this sensor and consider opportunities to start a new company focused specifically on this sensor. They plan to add $^{12}CO_2$ concentration measurement capability to the sensor, at which point it can be benchmarked against other measurement devices such as mass spectrometers to prove its potential for application in ICUs. Future plans including launching the senor commercially, either by helping Isomark, a different existing commercial entity, or by starting a new company. This research project has resulted in one disclosure to WARF.

11. Control and Data Management System for a Live Bone Loading Apparatus

The initial objective of this project was specifically designed to upgrade the control and data management of the bone loading system which is currently running on Windows 98 and internal controlling software in Delphi. As the result of collaboration with other researcher, additional funds were obtained and both the hardware and software were upgraded, and a new prototype system has been built. A second objective was to conduct two experiments in Dr. Smith's Laboratory bovine trabecular bone cores were to be studied, only was included in the final design. A new prototype bone loading system was built. Using the old loading, system bone cores were maintained viable for 21 days. The research demonstrated that exercised trabecular bone core increased significantly in stiffness over the 21 days compared to the sedentary controls. The bone cells demonstrated excellent cell viability as demonstrated in histological

sections. The increase in stiffness of the exercised bone cores indicate a greater resistance to fracture and will help in designing intervention studies in the prevention and treatment of osteoporosis. The overall impact on the total Wisconsin economy may be small; however, the impact on Simples Scientific, the Middleton, WI, company contracted to build the prototype will be significant. At the current time one beta system at $75,000 has been sold to a researcher in Adelaide Australia. Three to five other researchers have indicated an interest in obtaining a system and are looking for funds to purchase a system at a cost of $90,000 per system, either from their Universities or grant applications. In addition to the funds that were provided by the IEDR grant, Simples Scientific has invested an additional $25,000 in the project in time and materials to create an available commercial product. A Small Business Innovative Research (SBIR) grant was sent to NIH as part of the development of an overall business plan. In addition, two papers are in progress regarding this research.

12. Isotope Labeling of Small Molecules for Discovering Biomarkers of Colon Cancer

The research goal is to identify metabolites present in pre-malignant colon cancer lesions (polyps). The current work utilized samples from a type of mouse that serves as an excellent model for human colorectal cancer. Future work would measure these metabolites in blood or stool samples to screen, non-invasively, for colorectal cancer. Metabolomics data was obtained from multiple analyses of three tissue types (colon tissue from wild-type mice, colon tissue from treated mice, and polyp/lesion tissue from treated mice). Several metabolites were identified. Changes in key pathways (and potential biomarkers) are expected to be identified once the full analysis of data has been completed. If a metabolite or set of metabolites is found to indicate the presence of pre-malignant colon cancer, the collaborating company on this work, Stemina Biomarker Discovery, could develop and sell a clinical diagnostic assay to screen millions of people each year. Data for these experiments will be published immediately following analysis. Any biomarkers discovered in the analysis will be submitted to WARF for patenting. This data will serve as preliminary work for a full NIH R01 proposal, wherein the study will be expanded to include serum and stool samples.

13. Coating-Substrate Interlayer Development for Plasma Sprayed Coatings

Thermal barrier coatings (TBC) are ceramic coatings that are applied to a wide range of engineering components (e.g. jet engines in aircraft) to prevent the underlying alloy from being thermally degraded. TBC coatings are plasma sprayed, where particles of the coating material are melted and propelled onto the surface of the part to form a coating. One of the most common TBC is yttrium-stabilized zirconia (YSZ). A problem with TBC coatings is that they tend to debond from the alloy surface during high temperature use. This is caused by differences in thermal expansion between the coating and the alloy or by the permeation of the oxygen through the coating to the coating-alloy interface where it oxidizes the alloy which in turn lifts the coating off of the substrate. The goal of this research was to develop yttrium and tantalum based nanometer interlayer coatings that will prevent this debonding of the coating from the alloy substrate. The results are very promising. It was discovered that oxygen ion implantation of the pre-sputtered coatings of yttrium and tantalum dramatically reduced the propensity of the YSZ TBC coating from debonding from the alloy substrate. This is attributable to the formation of a thin yttrium/tantalum oxide that enhances the bond strength of the TBC coating to the substrate. It also reduces the oxidation of the alloy surface at the coating-alloy interface. The Wisconsin company Thermal Spray Technologies located in Sun Prairie is a nationally recognized company for plasma sprayed coatings. The company could benefit considerably from the use of this technology for specific engineering components and increase the reliability of their products. The research team plans to meet with personnel at Thermal Spray Technologies to discuss specific applications for this invention. There is one paper in progress for this project.

14. Nanoparticle-based Techniques for Manipulating the Bacterial Genome

This project uses fluorescent nanoparticles as vehicles for transporting material into bacterial cells. Using these materials the team of scientists will: 1) design quantitative mechanisms for transporting DNA and proteins into bacterial cells; and 2) use the transport properties of these particles to identify bacterial

mutants that have enhanced uptake properties that will be commercially useful in the Biotechnology sector. They have demonstrated conditions that promote the active uptake of nanoparticles into bacterial cells, have synthesized nanoparticles with hollow cores ('nanocages') for the delivery of genes and proteins into cells, and are now assessing the transport of these nanostructures. The team has partnered with Lucigen Corp. (Middleton, WI) to create and test mutants with this technique and will pursue any commercial products through their collaboration with Lucigen with oversight on intellectual property and technology transfer by WARF. While the preliminary results are positive, staffing changes in the research group decelerated the progress on this project in the past year. The lab is actively recruiting a first year graduate student or postdoctoral fellow to continue this research and will use the preliminary results to submit grants for long-term funding to support this research project.

15. Robustness of a Virus Infection Assay

This research builds the observation that fluid flows can be exploited to enhance the spread of viruses under controlled laboratory culture conditions, enabling a more sensitive measure of infection than previously attained. Since fluid flows have not been used in past to enhance the sensitivity of infection measures, this project sought to give the lab a better understanding of how physical processes (fluid flows) may interact with biological processes (cell and virus growth) to impact the patterns of infection spread that we use as a basis for infection measures. Specifically, the research objective was to identify ranges of virus inoculation levels, cell loadings, bolus-flow volumes, incubation periods and staining conditions over which our assay can perform robustly with high sensitivity. This IEDR-supported study has been useful to gain a better understanding of the range of parameters that the research team would need to control in order to attain more robust measures. They found that infection patterns are relatively insensitive to the size of a virus inoculum (number of virus particles), so long as a minimum threshold level is attained, but very sensitive the volume of fluid (bolus) used to transport an infection from infected to susceptible cells. These results will be useful as the team begins to explore applications of the technology to biomedically important targets such as influenza virus. The cooperating company, BellBrook Labs, provided custom-manufactured polystyrene culture vessels and expertise (Dr. Ivar Meyvantsson) that enabled the team to control flow for the culture of virus infections. At the same time, the study opened the company's perspective on potential applications of their expertise (microfluidics and controlled culture environments) in areas of virology. There have been three papers published as a result of this work and one is in progress. In addition, a NIH STTR grant application was successful that provided $300,000 per year for two years.

B. Applied Research Program

Applied Research Program projects are funded through a competitive process administered by the UW System Office of Academic Affairs and the WiSys Technology Foundation. The colleges and universities in the UW System seek to serve the public through a variety of educational services and scholarly contributions to society. Funding applied research is necessary to advance the Wisconsin Idea and the UW System's Growth Agenda which seeks to contribute directly to the growth of the economy in the state of Wisconsin through the production of new knowledge.

The WiSys Technology Foundation, Inc., derives its mission, goals and objectives from the charge of its parent corporation, the Wisconsin Alumni Research Foundation (WARF). WARF's mission is to support research at the University of Wisconsin-Madison by protecting and licensing inventions created by UW-Madison scientists, and returning the licensing proceeds to fund further research at the university. The

specific mission of WiSys, founded in 2000, is to support research and educational programs with high potential economic impact, particularly at the UW System comprehensive campuses and the UW Colleges. This support also includes funding for prototype development geared for commercial success. Since 2005, a part of the overall budget for the Applied Research Program has been made available to WiSys to assist in their efforts to patent and license research discoveries.

The Applied Research Grant program is quite competitive. Principal investigators from UW System institutions submit proposals documenting their realizable applied research goals and objectives and carefully document funding needed to achieve outcomes that may lead to patent production, technology transfer, and entrepreneurial impact. All proposals are reviewed and rated by a panel comprised of representatives of UW System institutions who are experts in applied research fields, representatives from WiSys, staff members from the UW System Office of Academic Affairs, and industry representatives. In addition to the quality of the research design and likelihood of successful completion, a major criterion for selection and funding is the likelihood of a positive impact of the project on Wisconsin's economy and industry-research partnerships as well as technology transfer.

In 2007-08, 47 proposals requesting a total of $2,331,609 were received. Eight of these projects, some of which were inter-institutional proposals, received funding in the total amount of $378,950 and the WiSys Technology Foundation received stipends which provided prototype development funds to 4 UW System researchers and supported patenting and licensing.

In 2008-09, 46 applications for funding requesting a total of $2,167,972 dollars were received. Nine UW campus proposals, some of them collaborative and interdisciplinary, were funded in the total amount of $367,149. Further funding included a grant to WiSys to support 5 prototype development grants and a stipend to cover patenting and licensing costs.

Applied Research Program Awards, Fiscal Year 2007-08

See Appendix C for a list of investigators, departments, and amounts of the awards.

1. Nanophase Phosphors with Potential Use in Solid-State Lighting (SSL) Devices
Solid state lighting devices have a huge potential market in Wisconsin and throughout the world for different kinds of high tech industry uses. Effective and efficient use of solid-state lighting devices depends on the development of new phosphors, in particular nanophase phosphors. These new style phosphors are well-suited for use in solid-state lighting devices because they produce a high-quality broad-band white light that compares well to natural sunlight. Researchers created several marketable nanophase phosphors prototypes with nano-scale zinc sulfide and zinc-cadmium sulfide. The outcomes of the project include thus an inexpensive method for synthesizing these nano-scale phosphors and the researchers now seek to produce and market them large-scale to industry. Research continues on post-processing conditions and other syntheses combinations that will allow the researcher to create self-contained prototype solid state lighting devices.

2. Development of Artificial-Tissue Methods for Potential Vaccine Production
In this project, the researcher undertook applied research to improve advanced vaccine production methods, which are highly prized by the pharmaceutical industry. Through tissue engineering the researcher developed a new application for immunology purposes. The research identified and isolated bioactive materials from natural materials which are responsible for cell behavior. Using preliminary data already collected, the researcher developed and applied artificial tissues in vitro. These in-vitro antigen production methods were developed on the basis of cell-line artificial tissues and showed their capacity for viral antigen production. An examination of brain, lung and heart artificial tissues by scanning electron microscopy (SEM) confirmed that the artificial tissues do indeed develop a distinctive set of

interior, exterior and large-scale tissue-like characteristics. Research was conducted on the brain, heart, lung, liver, and bone from several different stages of origin and culture duration. Since artificial tissues are complex and dynamic, follow up studies will include the improvement of artificial tissue sample sectioning and protein analysis as well as developing data on soluble "antigens."

3. Capturing Commercial Value of Super High-Oil Corn through Molecular Marker Assisted Breeding
The commercial corn market has long been looking for the development of corn hybrids that yield high levels of oil in order to increase earning capacities for corn farmers. While generally available high-oil corn hybrids are under development, at the time the research commenced, and depending on conditions they generally reached 7% oil content. The researchers were able to produce a faster and more efficient development process that led to quicker production of high-yielding oil corn hybrids. The process used was to identify DNA markers that are linked directly to the high-oil trait. The researchers were able to identify some of these DNA markers through molecular analysis in the lab but also through on-site evaluation, crossing, and pollinating at facilities owned by the University of Wisconsin and a commercial partner. The outcome of the project was the increase of oil yield in specific hybrids by at least 5%. This higher yield will result in higher incomes of corn per square acre by farmers who use the new hybrid. Additionally, the high-yield corn can be utilized in biodiesel production and increased nutritional value for animal feed.

4. Nano-Composite Polymer Strip Coatings, Protectants, Electrodes and Decontamination Films
The researchers' project involved the development of non-flammable polymer strip coating for the nano-technology industry, including high-tech optics and laser cleaning, protecting and storing. Polymer Coatings and protectants were developed in the lab and were made made market-ready for use in the cleaning and decontamination of high end laser optics, semiconductator and high vacuum surfaces and precision surfaces. On the basis of this research multiple commercial product lines were developed and are now used widely for atomic-level nano-cleaning. As diverse polymer coatings were developed, they also proved usable for electrode materials. The company photonic cleaning technologies was formed to serve customers who needed telescope mirrors and diffraction gratings cleaned. Project partners that used the residue-free polymer strip coating included aerospace industries, NASA, the Smithsonian in Washington, D.C., and operators of large telescopes in Hawaii as well as high-tech optics companies in Europe. Multiple patent filings occurred and the research is now directed carbon nanotube solubility, economic grapheme on an industrial scale by dissolving graphite. Photonic Cleaning Technologies has sales in 55 countries. A new company, Graphene Solutions, LLC, was formed based on the results of the graphene research and was profiled in *Business Week* in October 2008 as one of 30 hot startups in the USA.

5. Bringing Ground Squirrel Captive Breeding Technology to NIH Standards
As a collaboration of UW-Oshkosh and UW-La Crosse, the objectives of this project were to develop an advanced, patentable breeding technology and to use ground squirrels as animal models for studies of visual function and therapeutic hibernation ultimately to be used in human therapy. Breeding colonies were established at both institutions. From 30 breeding pairs, the researchers obtained 24 litters for a total of 168 captive-bred offspring. They also trapped an additional 6 wild females for a total of 4 wild-bred litters and 32 offspring. These will be bred into existing stock to promote genetic diversity and robust hibernation. Breeding pairs were transferred to the National Eye Institute at the NIH in 2008. The researchers obtained hemostasis and retinal detachment preliminary data from ground squirrels. Some formal documentation of animal colony health was achieved. The researchers still seek to strengthen animal sales and to attract licensees as well as obtain additional federal funding. In the future, the researchers will pursue the marketing of a fixed formula to area companies specializing in animal feed and the sale of the user's manual generated sales. Because of the departure of one of the key researchers, ocular and hibernation research was not completed but colony animals were used by other researchers nationally and internationally.

6. High-speed Parallel Magnetic Resonance Imaging: Development, Implementation, and Applications
This project was geared at developing new image reconstruction algorithms for parallel magnetic resonance imaging devices and thus to promote competitiveness in this vital area of healthcare technologies. An efficient algorithm needed to be developed to achieve optimal results in parallel imaging. The researchers developed an effective algorithm that accurately estimates sensitivity functions without need of a calibration scan for accuracy. The performance, measured in terms of both imaging acceleration and image quality, is superior to other devices. The research led to successful collaboration with research partner GE Healthcare Technologies, a Wisconsin-based business earning $10 billion in annual revenue and providing employment for about 6,700 people in Wisconsin. Results were published in refereed journals and the imaging speed results are leading to valuable intellectual property and licensing. A patent has been filed by the UW-Milwaukee Research Foundation.

7. Investigation of Ultrasonic Stimulation of Supercritical and Near Supercritical Carbon Dioxide Treatment of Wood for the Extraction of Hemicelluloses
This collaborative project involving several UW system institutions addressed the great interest in using biomass for the production of ethanol. The paper industry is already a major collector of biomass in the form of wood. In the pulping process, however, one of the key ingredients, hemicelluloses, is degraded by the pulping chemicals. The investigation evaluated the potential for removing the hemicellulose sugars prior to pulping so as to enhance the efficiency of the pulping process and produce a stream of sugars that are readily fermentable to ethanol. This provided a transitional step for converting a pulp and paper operation to a biorefinery. Although this study did not result in the detection of pure sugars released from the aspen, there were a number of useful outcomes. First, it was consistently demonstrated that reactions conducted with supercritical carbon dioxide removed a larger mass of wood than by treating with acid alone, even at a relatively low temperature (~50°C). The researchers concluded that a sonicaton treatment removed the greatest mass of wood, followed by supercritical carbon dioxide, followed by reaction in an oven. Future research will be focused on constructing an experimental set up that will allow for higher temperature reactions to be conducted.

8. Techniques for Efficient Wireless Transcutaneous Power Signal Transmission for Left Ventricular Assist Devices
The research conducted with funding from the Applied Research Grant led to the Design and implementation of a prototype wireless transcutaneous power transfer system. The researcher also designed, modeled and implemented an integrated power electronics converter that collects power from output of the internal coil, charges a battery, and supplies the load. The total efficiency from output power to the internal battery and to the motor was measured at 86%, which is much superior to a system with multiple stages. A digital controller system was also designed and implemented. The controller is used for the internal part control of battery charging/discharging, driving the motor, and communicating with the external control unit. A patent was filed based on these results by the UW-Milwaukee Research Foundation.

Applied Research Program Awards, Fiscal Year 2008-09

See Appendix D for a list of investigators, departments, and amounts of the awards.

1. Development of High Performance Solar Absorbing Nano-Coating for Use in Solar Water Heating System
The goal of the project concerned to develop coatings for protection of solar waterheating systems. The researchers addressed a specific problem identified by the company Bubbling Springs Solar, which related to the thermal coating applied in their thermal solar water heating system. The newly developed coating system has the potential offers two benefits: 1) elimination of the use of petroleum based spray

coating and replace this with a water based coating that could be sprayed or dip-coated; and 2) increased solar performance of coating used in the solar thermal panels. The newly developed nano-composite coating has increased performance by incorporation of carbon nanotubes which offer desirable solar absorption and thermal conduction. Qualified systems for solar water heating systems can earn the customer up to 25% of the total cost of equipment and installation. Through the researchers' development of a new nano-coating, consumers with a solar hot water system can meet 75% of their hot water needs and save about $500-$750 annually, i.e. (60-80 gallons/day). After the completion of large scale testing, a patent was filed based on the results of this research.

2. A Lignin/Solvent Based Transportation Fuel

Wisconsin has no fossil fuel reserves and must import nearly all of its energy. In order to develop use of domestic and regional energy sources, the Department of Energy has mandated the production of 60 billion gallons of biofuel per year by 2030. The goal of program was to address this mandate and to develop advanced biofuels that can be made economically from Wisconsin's agricultural and forest products resources, including pulp from the paper-making industry. This project also used Wisconsin's wood/paper cellulose-based biomass as the logical source for biofuel production. Wisconsin pulp mills currently produce approximately 3,250 tons of chemical pulp per day consuming 6,500 tons of wood. During the pulping process wood is chemically separated into pulp, which is mainly cellulose and liquor, which consists essentially of dissolved lignin, hemicellulose, and spent pulping chemicals. The mills use pulp to make paper products and burn the liquor to recover the pulping chemicals and generate steam and electricity. This project succeeded in chemically separating wood into its three main components and in generating a higher-energy value liquid fuel. A utility patent was filed by the principal investigator for this work.

3. Synthesis and Pre-Clinical Testing of 2-Aminoquinoline

New drugs are needed to treat infections of humans by Burkholderia cepacia, Pseudomonas aeruginosa, and Stenotrophomonas maltophilia. This interdisciplinary study proposed to synthesize the compound 2-aminoquinoline and other substances to find ways to control these infections. The drug was put through a battery of pre-clinical tests for in vitro efficacy and safety. Originally, the researchers proposed to finish all pre-clinical tests that are required to initiate a Phase I clinical trial in humans, bringing the drug one step closer to being approved for human use. Their testing, however, showed that the compounds were toxic and therefore had to be abandoned. However, in the mean time several new compounds were tested and found non-toxic. Researchers will work with the UW-Madison School of Pharmacy to optimize formulation and are engaged with other UW and Wisconsin clinical service providers.

4. Plastics and Rubber Nanocomposites for Building and Safety Shoe Products

The goal of the project is to improve the competitiveness of Wisconsin special market shoe producers. In order to accomplish better, safer, and more economically produced raw materials for these shoes, the researcher began basic research on producing a new form of cellular foam and new rubber composites for shoe production. These high tech new materials improve the mechanical and physical properties of these shoe products by utilizing a nanoclay polymer, which is low cost. Wisconsin-based shoe companies that produce over 30 million pounds of vinyl moldings every year and shoes worth at least $50 million are working with the researcher to adopt the newly developed materials. The foam and rubber improve resistance to fire, flexibility, and durability. Currently, the project's principal investigator is looking at wider ranges of applications for these products.

5. Synthesis and Biological Evaluation of Transforming Growth (TGF) Factor b Modulators for the Treatment of Transforming Growth Factor Mediated Diseases

The goal of this project was to synthesize and characterize compounds from a family of proteins used to treat TGF mediated diseases, in particular by regulating cell growth, controlling inflammation and immune-suppression. Excessive production of the protein compound TGF-ß has been confirmed in many cancers and fibrotic disorders. However, by blocking of TGF-ß using antibodies, the disease can be

prevented or reversed. Target compounds were analyzed using computer modeling and chemical informatics software. The researcher found and synthesized new compounds with increased potency in fighting the disease. Together with colleagues at the Marshfield Clinic Research Foundation the researchers screened about 30,000 compounds from the National Cancer Institute of Developmental Therapeutics. Based on the results of the compound screening, one of the researchers filed a patent application on a group of structurally related compounds and their ability to modulate TGF-ß activity in the prevention or treatment of TGF-ß mediated diseases such as cancer and fibrotic disorders

6. Tumor Stem Cell Modeling in 3-D Cultures

After producing complex 3-D artificial tissues from virtually organ systems of the avian body and from numerous cell lines including human embryonic stem cells (HES), the researchers found that their scaffolding materials and/or culture conditions were particularly well suited to the growth and maintenance of stem cell populations of both fetal tissue and embryonic origin. In order to address "tumor stem cells" in breast, lung and other human soft tissue tumors, the proposed purpose of this project was to develop a method of harvesting and culturing critical stem cells. The resulting cultures were then utilized to study the possibilities for use in chemotherapy and to develop detection methods and eventual treatment for tumors. It is expected that the research will help to yield large quantities of concentrated antigens from highly specialized tumor stem cells in vitro and in research and clinic applications. The antigens will then be applied to develop a new set of tumor stem cell specific immune-reagents which can be utilized in both research and clinic applications. Work is under way to start a new biotechnology company in western Wisconsin which eventually could employ as many as 20-40 individuals working on both manufacturing and research as well as product development in this critical clinical arena.

7. Electrochemical Deposition of Nanowires: Going from a Scientific Curiosity to a Commercial Process with Wide Ranging Applications

The researchers started with a plan for growing large quantities of nanowires for a wide variety of materials by electro-deposition. The principal investigator had previously discovered a technique which grows nanowires and when applied, it produced, for instance Tungsten nanowires which then can be used to make diamond nanowires. Oriented and patterned diamond nanowires were shown to give machine tools wear properties with a potential for self sharpening tools. The researcher was able to grow these wires in the laboratory without the expensive equipment normally associated with making patterned. The wires have many potential applications such as sensors, thermoelectric devices, and providing electrical contacts to nanoparticles of other materials for circuit components. The project's use of simple equipment and the resulting high yields of uniform nanowires render the resulting techniques as highly suitable for mass production of nanowires and nanowire devices.

8. Study of a Porous –Based Radiant Burner System

This project was designed to improve the production rate in the paper mill industries of Wisconsin. In the process of paper burning, more energy efficiency is highly desirable to increase profitability. Further, more environmentally conscious methods will benefit all and keep the industry competitive in the light of system modifications and international market pressure. The researcher's efforts were geared towards developing an innovative paper heating burner system by computational modeling and testing. This type of heater is operated by a porous media burner which makes the flames on the surface of the media distributed uniformly. This new burner system increases efficiency and uses less energy by eliminating hot spots and increasing combuster life. It also suppresses velocity and temperature oscillations while enhancing thermal performance. In this way, production losses can be minimized and capabilities for production can be extended.

9. High Resolution Dynamic Contrast Enhanced Magnetic Resonance Imaging of Cancer

In order to improve cancer therapies, the researchers set out to develop a novel and improved image reconstruction technique for high resolution dynamic contrast enhanced magnetic resonance imaging

(DCE-MRI). The technique is based on the new compressed sensing theory recently developed by mathematicians and is expected to increase resolution of a high resolution contrast MRI by a factor of 100. The project investigated optimal sampling matrices for compressed sensing in DCE-MRI, and evaluated the technique in real DCE-MRI applications. This project improved competitiveness of the commercial partner, GE Healthcare Technologies, which is a key player in the Wisconsin economy. The researchers are pursuing patenting and seek to generate revenue through licensing.

C. Center for Dairy Profitability (UW-Extension/UW-Madison)

The University of Wisconsin Center for Dairy Profitability (CDP) is a multi-campus Extension unit with faculty and staff at UW-Madison, UW-Extension, UW-Platteville, and UW-River Falls. The CDP develops, coordinates, and delivers interdisciplinary educational programs which emphasize integrated production, financing, and marketing management systems to improve dairy profitability and the competitiveness of Wisconsin's dairy industry. David W. Kammel, UW-Madison Department of Biological Systems Engineering, is the current director.

The CDP receives funding from the Industrial and Economic Development Research Fund (IEDRF). In 2008-09, the IEDRF provided $366,795 to fund 3.18 FTEs that were allocated as follows: 2.49 at UW-Madison; 0.29 at UW-Platteville, and 0.40 at UW-River Falls, along with funding to cover the cost of supplies and other expenses at the center location on the UW-Madison campus.

The economic success of Wisconsin's dairy industry contributes $26.5 billion of dairy revenue annually, at the rate of more than $50,000 per minute. Every job in dairy supports an additional 1.23 jobs elsewhere in the Wisconsin economy. This work force depends largely on the knowledge and management skills of dairy farmers and agribusiness professionals who work with them. Their decisions will determine whether the state's dairy industry is competitive and prosperous over time. Informed management decisions are a key to dairy farming's economic success. The CDP's emphasis is on educational programs that enhance the management skills and decision-making abilities of dairy producers and others who assist them in making management decisions. In these difficult economic times, the information developed by CDP is especially important for farmers to make informed decisions on the viability and profitability of their individual businesses. In fact, there has been a substantial increase starting in 2008-09 in requests for financial management information through County Extension offices and response that CDP has been able to provide to producers.

This section describes the CDP's educational programs. It also contains examples of how the CDP facilitates the development of multi-disciplinary educational programs and partners with other agencies, such as the Department of Agriculture Trade and Consumer Protection and the Department of Commerce, that share its goal of enhancing the profitability of the dairy businesses and enhancing business development in Wisconsin and throughout the world.

The Center for Dairy Profitability leverages its limited resources by cultivating key collaborations with professionals and organizations in the agriculture industry throughout Wisconsin. CDP staff work in conjunction with UW-Extension agriculture agents to develop educational programs, materials, speakers, and financial support for programs to help dairy and agricultural producers. Equally important is the relationship between CDP and the Lakeshore and Fox Valley farm management associations. The majority of the farms in the AgFA© database are gathered through these two associations. Wisconsin Technical College (WTC) farm business instructors also collaborate with the CDP in providing financial record-keeping workshops and financial analysis for dairy producers in all parts of the state. Other collaborations include:

- Farm Credit Services: Badgerland & AgStar

- Wisconsin Department of Agriculture, Trade & Consumer Protection (WDATCP)
- Wisconsin Farm & Rural Appraisers Association
- Wisconsin Frame Builders Association
- Wisconsin Custom Operators Association
- Grow Wisconsin Dairy Team (WDATCP)
- Grow Wisconsin Farmers Working Group
- Dairy 2020 (Wisconsin Department of Commerce)
- Southwest Wisconsin's Regional Dairy Modernization Task Force

Extension Educational Programs

The CDP is involved in a variety of management education programs that are intended to teach farm managers and agribusiness professionals about practices to improve the performance and profitability of farm businesses. The following is a brief summary of some of these programs:

Extension Responds- Farming in Difficult Times
With the current difficult economic situation Cooperative Extension and specifically CDP has a focused effort to develop and provide relevant resources and information on how to manage through these difficult times. The web site: http://www.uwex.edu/ces/ag/farmingindifficulttimes.html was developed and populated with articles and decision tools by faculty and staff in CDP and UW Extension. It is timely and extremely important to provide a support system for farm families and businesses to help them make informed decisions. The DATCP Farm Center, directed by Paul Dietman, cooperates in making suggestions for the types of information that are made available on the site according to their call records and discussions with farmers using the call center.

Agriculture Financial Advisor (AgFA@)
Begun in 1999, under the direction of Gary Frank (UW-Madison), this computerized financial analysis system serves dairy producers and others to summarize and analyze the annual financial performance of farm businesses. This financial summary package allows individual farmers and/or their advisors to compile annual financial reports and records in a standardized format.

The Agriculture Financial Advisor (Agfa @) is currently being used by the Lake Shore and Fox Valley farm management associations, several Wisconsin Technical College Boards, and county educators. It is an integral part of the Farm Financial Management Project. AgFA @ records data gathered by farm management associations and is an important part of the *AgVentures* -- Building a Vision [Financial Management and Strategic Planning] and Returning to the Farm curricula. AgFA@ yields valuable information about the financial status of these farms, giving farmers, farm managers, and their advisors cost of production and other financial measures, such as rates of return on assets and on equity, and debt to asset ratio. These economic and financial benchmarks can be used to determine how their farm businesses compare to others. The financial benchmarks and publications resulting from the economic data analysis are used extensively in dairy extension programs, and permit lenders, policy makers, and agribusiness professionals to help producers become better managers and more profitable farmers. This information is available in hard copy or on the website: (http://cdp.wisc.edu/AgFA.htm).

Agricultural Accounting and Information Management Systems (AAIMS@)
The Agricultural Accounting and Information Management System (AAIMS@) is a computerized agricultural accounting system maintained and updated by Gary Frank and Jenny Vanderlin (UW-Madison). Training workshops are held across the state throughout the year through UW-Extension and the Wisconsin Technical College System. Since its latest release in January of 2002, several hundred copies of the program have been sold to farm managers through both the Heart of the Farm program and

the Grow Wisconsin Dairy Team initiative. This information is available in hard copy or on the website: (http://cdp.wisc.edu/Software.htm).

AgVentures

The *AgVentures* program, coordinated by Jenny Vanderlin (UW-Madison), is a fee-based management education program for farm managers. Through this program, farm managers learn about management concepts and their application to the problems they face when operating their farm businesses. *AgVentures* has been designed to provide these farm managers ample opportunities to familiarize themselves with a number of management topics. Using hands-on activities and case studies, farm managers learn about management concepts and their application to farm management issues. Farm managers can choose from six modules: Got Risk? (risk awareness), Building a Vision (financial management & strategic planning), Human Resource Management, Business Arrangements & Farm Transfers, Dairy Price Risk Management, and Grain Marketing. Each module contains approximately 15-20 hours of curriculum and is available on CD-ROM or through the website: (http://cdp.wisc.edu/AgVentures.htm).

Dairy Modernization and Technology Adoption

According to the Wisconsin Agricultural Statistics Service (WASS), the number of Wisconsin dairy farms continues to decline. By the end of 2007, the number had fallen to approximately 14,400, with an average herd size of 86 cows. Most of the farms (11,600, 81%) with less than 100 cows are still operating with tie/stanchion stall barns, and associated feeding, milking, and manure handling procedures. These systems are labor intensive and inefficient. The majority (68%) of farmers in this group are between 40 and 60 years of age. Over half of the farms with fewer than 200 cows plan on making investments in housing, milking, feed storage or manure handling facilities in the next 5 years. As these farmers struggle with the future of their dairy farm operations, they need information and education on available options. David Kammel and the CDP staff, in cooperation with the UW-Extension Dairy Team, provide information, decision aids, and educational programs that allow farmers to determine whether and/or how to adopt technology and modernize, and permit farmers to develop their businesses, enhance profitability, and improve their quality of life. Several grants are being used to collect financial record information using the AgFA@ database to measure technology adoption and its economic impact on the dairy business. Web Site Address: (http://www.uwex.edu/ces/dairymod/index.cfm).

Dairy Revitalization

There are currently seven educational projects under the direction of CDP faculty and staff, in cooperation with the UW-Extension Dairy Team. These projects are funded by a federal Dairy Industry Revitalization Grant made available through the efforts of Senator Herb Kohl and Representative David Obey. Educational workshops present dairy modernization options and provide information to producers on how to enhance their modernization practices with business planning grants (Dairy 2020), and the Milk Volume Program (MVP) from the Department of Commerce (DOC).

Heart of the Farm- Women in Agriculture

The Heart of the Farm Conference Series continues to empower Wisconsin farm women in production, price, and financial, legal and human areas of risk management education. The Heart of the Farm Conferences brings women together in a professional setting and increases their knowledge and competence in farm business management skills and production. These conferences are a vehicle to decrease the social isolation experienced by many farm women by providing opportunities to network with their counterparts. Annie's Project – Heart of the Farm, Phase II, is a five-session series that trains farm women to manage agricultural information systems, engage in critical decision-making processes, and build support networks with other women throughout the state. This program is also partially funded through a separate competitive grant from the North Central Risk Management Education Center.

Farm Business Transfers

Returning to the Farm (RTTF) is a project designed to address the human, legal and financial risks involved into the transfer of the farm to the next generation. It attempts to reach college junior and seniors who are planning on returning to their home farming operations. The project includes two weekend sessions held in the fall and spring. Each student and the farming family members are required to attend both sessions. Communication, conflict management, financial analysis of the farm, strategic planning, business arrangements, retirement planning and estate planning are covered in the two sessions. Consultations are offered between the two sessions to analyze the financial capacity of the farm. Sixty-eight people representing 23 farm families have participated in a *Returning to the Farm* workshop since 2005. Evaluations from the workshops indicate participants used the tools provided to help analyze their farms and develop farm succession plans. RTTF is partially funded through a separate Dairy Revitalization Grant sponsored by Herb Kohl and David Obey and a competitive grant from the North Central Region Risk Management Education Center.

Communication Skills Support Farm Transfer Success has three components: a survey of Southwest Wisconsin; the development of a farm transfer workbook and facilitator guide; and additional educational programs. This program is also partially funded through a separate competitive grant from the North Central Risk Management Education Center. Web site: (http://www.uwex.edu/ces/farmsuccession/index.cfm).

Risk Management

The UW-Extension's Farm and Risk Management (FARM) self-directed team, in cooperation with the CDP staff, developed the risk management and business planning modules of the *Ag Ventures* curriculum. Kevin Bernhardt (UW-Platteville), Gregg Hadley (UW-River Falls), and Jenny Vanderlin (UW-Madison) support these educational programs which are used by farm managers, county extension agents, and agricultural professionals. Web Site: (http://www.uwex.edu/ces/ag/teams/risk/).

Wisconsin Assessment Center for Dairy Farm Owners/Managers

In today's changing farm environment, dairy farm managers are required to take on more of a managerial role. Specialists from the CDP and a team of UW-Extension agricultural agents designed the Management Assessment Center for Dairy Managers. The assessment center curriculum was developed, tested and implemented to help dairy farm managers understand their own competency levels as they relate to selected managerial attributes. Each assessment center includes a two-day program where producers participate in a series of activities which help assessors evaluate individual managerial strengths and areas needing improvement. Following the program, producers are given a detailed individualized report and a personal consultation. A resource guide is provided that assists them in developing a plan for self improvement. To date, five assessment centers have been offered and 44 dairy managers and agricultural professionals have participated in the assessment program. Evaluation results have been extremely encouraging and there is an increasing demand to modify the curriculum for other commodity groups as well. This project was partially funded through a separate Dairy Revitalization Grant sponsored by Herb Kohl and David Obey. Web Site: (http://cdp.wisc.edu/MAC.htm).

Regional Dairy Modernization Task Force

The Regional Dairy Modernization Task Force is a multi-state effort coordinated by Kevin Bernhardt and serving Southwest Wisconsin, Northeast Iowa, and Northwest Illinois. It is a coalition of approximately 14 private and public organization representatives. Its goal is to be a catalyst for dairy modernization in this region. It continues to be successful in developing, organizing and implementing educational activities for those who desire to modernize. Activities include an annual Dairy Summit IV in 2008 and the Pathways to Success meetings held throughout the year. The Task Force has coordinated 42 events since 2003 and served over 2,000 attendees. A survey of participants showed that 57% of the survey participants had modernized and that the decision to do so by 83% of them had been influenced by task force events.

Economics of Dairy Herd Management Decisions

In cooperation with faculty from the UW-Madison Department of Dairy Science, and in response to dairy managers' questions, Bruce Jones has developed several economic analysis tools for dairy herd management, covering such topics as economics across dairy breeds, extended dry period, crop replanting options, and alfalfa substitution for corn silage. Such analyses can be developed quickly and made available to county extension educators to address similar situations on other farms, thereby reducing potential economic losses that could occur as a result of an uninformed decision process.

Agricultural Budget Calculation Software (ABCS@)

The CDP maintains a computerized database to estimate the cost of producing crops under various scenarios. This budget generator (ABCS@) is used to evaluate the economics of crop-related problems. Both the UW-Extension Grains and Forage teams use it to produce enterprise budgets that are placed on the website: (http://cdp.wisc.edu/Software.htm). Currently, budgets are available for several different commercial vegetables, cash grain, and livestock.

Decision Making Aids

With the goal of keeping Wisconsin's dairy industry competitive, the Center and affiliates have developed a number of tools to help improve production efficiency and profitability. Collaborations include developing spreadsheets based on scenarios posed by producers and others that may be used in making management decisions. County Extension Agents and financial consultants use these spreadsheets to assist dairy farm managers in creating financial plans for modernization and/or expansion. Enterprise budgets are also available for dairy, replacement dairy stock, swine, and beef. These decision aids can be found on the website: (http://cdp.wisc.edu/Decision%20Making%20Tools.htm).

Babcock Institute

The Babcock Institute for International Dairy Research and Development at the University of Wisconsin–Madison offers programs to foreign nationals. Brian Holmes and David Kammel (UW- Madison) have served as instructors for the Babcock Institute programs.

Publications

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Internet Sites

Center For Dairy Profitability Website
http://cdp.wisc.edu
Since 1995, the Center for Dairy Profitability has maintained a home page. The new homepage design was created to enhance access and retrieval of educational information. This site has a wealth of

information of value to dairy producers and other professionals making economic decision in their business.

Heart of the Farm Website
http://www.uwex.edu/ces/heartofthefarm
Developed in 2002, this site promotes educational programs, conferences, and resources of interest primarily to farm women.

Team Forage – Harvest and Storage Web Site
http://www.uwex.edu/ces/crops/uwforage/storage.htm
In conjunction with the Harvest and Storage Workgroup of the UW-Extension Forage Team, Brian Holmes has developed a webpage dedicated to improving decision making about forage harvest and storage. This work has been instrumental in improving producers' understanding of the relationship between proper forage storage and reduced loss.

Dairy Modernization Website
http://www.uwex.edu/ces/dairymod/
Developed in 2006 this site provides educational materials and links for farmers and other agricultural professionals on technology of modernizing the dairy farm.

FARM Team Website
http://www.uwex.edu/ces/farmteam
Released in Fall 2007.

Appendix A
Industrial & Economic Development Research Program (IEDR) Grants
2007-08

Investigator	Department	Amount	Title
Suman Banerjee	Computer Sciences	$46,328	*Towards Cost Effective Design and Management of City-Wide Wireless Grids*
David Beebe and Tim Kamp	Biomedical Engineering and Medicine	$45,250	*HTS Microfluidics for Cardiac Screening*
Sean Fain and Gale Sisney	Medical Physics and Radiology	$49,808	*Device for MRI-guided Biopsy and Therapy of Breast Cancer*
Kreg Gruben	Kinesiology	$45,860	*Foot Force Direction Training for Rehabilitation and Fitness*
Robert Hamers	Chemistry	$47,782	*Carbon Nanofiber Supercapacitors and Supercapacitor-Battery Hybrid Devices*
Richard Hartel and JoAnne Robbins	Food Science and Medicine	$46,532	*Development of Biophysically-Based Fluids for People with Swallowing Disorders*
Song Jin	Chemistry	$48,980	*Enabling Atom Probe Tomography using Silicon Nanwire Arrays as Microtips*
Krishna Kurpad	Radiology	$44,532	*Focused RF Heating Mechanism for Thermoacoustic Tomography*
M. Elizabeth Meyerand and Mitchell Tyler	Biomedical Engineering and Medical Physics	$47,360	*Using Functional MRI to Study Balance Control in the Human Brain*
Michael Oliva and Lawrence Bank	Civil and Environmental Engineering	$33,532	*Durable Fiber Reinforced Polymer Connections for Precast Concrete Structures*
Jorge Osorio and Yoshihiro Kawaoka	Pathology and Laboratory Medicine	$48,032	*Recombinant Vaccines Against Avian Influenza Viruses*
Susan Paskewitz	Entomology	$12,420	*Evaluation and Improvement of Novel Traps for Mosquitoes and Other Insects*
Lloyd Smith	Chemistry	$27,032	*SPR Compatible Carbon Thin Films for Microarray Fabrication and Analysis*
Jon Thorson	Pharmaceutical Sciences	$50,000	*Novel Tools for Atomic Resolution Nanoscale Analysis: Combined Atomistic Modeling and Atom Probe Methods*
Kevin Turner	Mechanical Engineering	$46,782	*Development of a Nanomechanical Method Characterizing Single Cell Adhesion*
Orhan Unal	Radiology	$30,697	*Multi-mode MR Intravascular Probes with RF Ablation Capacity*
John Yin	Chemical and Biological Engineering	$40,032	*Microfluidic Virus Infection Assays*

Appendix B

Industrial & Economic Development Research Program (IEDR) Grants

2008-09

Investigator	Department	Amount	Title
Aseem Ansari	Biochemistry	$49,600	*Application of Cognate Site Identifier Arrays to Drug Target-DNA Interactions*
Dan Botez	Electrical and Computer Engineering	$50,000	*High-Efficiency Mid-Infrared Semiconductor Lasers*
William Dove	Oncology	$49,342	*Impact of Vitamin D Analogs on Experimental Colon Cancer in Rats*
Kevin Eliceiri	Molecular Biology	$47,538	*Development of Multiphoton Flow Cytometry for High Throughput Studies*
Ying Ge	Physiology	$49,998	*Enrichment of Phosphopeptides using Nanomaterials for MS-Based Proteomics*
Robert Jeraj	Medical Physics	$49,335	*Dual-Modality Radiation Therapy*
Max Lagally	Materials Science and Engineering	$49,993	*Develop Novel Micro-Arc Plasma Tool for Localized Surface Functionalization*
Dan Morgan	Materials Science and Engineering	$31,620	*Development of a Universal Anode for Water Heaters*
Heidi Ploeg	Mechanical Engineering	$49,048	*Characterization of the Morphological, Mechanical and Biological Properties of Seeded Bone Scaffolds*
Scott Sanders	Mechanical Engineering	$50,000	*Simple and Affordable Human Health Monitor based on a New Laser Technology*
Everett Smith	Population Health Sciences	$41,480	*Control and Data Management System for a Live Bone Loading Apparatus*
Lloyd Smith	Chemistry	$49,968	*Isotope Labeling of Small Molecules for Discovering Biomarkers of Colon Cancer*
Kumar Sridharan	Engineering Physics	$44,575	*Coating-Substrate Interlayer Development for Plasma Sprayed Coatings*
Douglas Weibel	Biochemistry	$50,000	*Nanoparticle-based Techniques for Manipulating the Bacterial Genome*
John Yin	Chemical and Biological Engineering	$50,000	*Robustness of a Virus Infection Assay*

Appendix C
Applied Research Program Awards
2007-08

Investigator	Campus	Amount	Title
Charles Gibson	UW-Oshkosh	$48,991	*Nanophase Phosphors with Potential Use in Solid-State Lighting (SSL) Devices*
Tim Lyden	UW-River Falls	$50,000	*Development of Artificial-Tissue Methods for Potential Vaccine Production*
Steve Carlson	UW-River Falls	$50,000	*Capturing Commercial Value of Super High-Oil Corn through Molecular Marker Assisted Breeding*
James Hamilton	UW-Platteville	$50,000	*Nano-Composite Polymer Strip Coatings, Protectants, Electrodes and Decontamination Films*
Dana Vaughan, et.al.	UW-Oshkosh & UW-La Crosse	$66,835	*Bringing Ground Squirrel Captive Breeding Technology to NIH Standards*
Lei Ying	UW-Milwaukee	$42,053	*High –Speed Parallel Magnetic Resonance Imaging: Development, Implementation, and Applications*
Franklin Chen, Michael Zorn & David Hollenberg	UW-Green Bay	$21,070	*Investigation of Ultrasonic Stimulation of Supercritical and Near Supercritical Carbon Dioxide Treatment of Wood for the Extraction of Hemicelluloses*
Adel Nasiri	UW-Milwaukee	$50,000	*Techniques for Efficient Wireless Transcutaneous Power Signal Transmission for Left Ventricular Assist Devices*

Appendix D
Applied Research Program Awards
2008-09

Investigator	Campus	Amount	Title
Forrest Schultz	UW-Stout	$29,099	*Development of High Performance Solar Absorbing Nano-Coating for Use in Solar Water Heating System*
Don Guay	UW-Stevens Point	$49,889	*A Lignin/Solvent Based Transportation Fuel*
Bill Schwan, Aaron Monte & Marc Rott; David Lewis	UW-La Crosse collaboration w/ UW-Eau Claire	$52,693	*Synthesis and Pre-Clinical Testing of 2-Aminoquinoline*
Nidal Abu-Zahra	UW-Milwaukee	$24,487	*Plastics and Rubber Nanocomposites for Building and Safety Shoe Products*
Karl Peterson	UW-River Falls	$49,792	*Synthesis and Biological Evaluation of TGF-b Modulators for the Treatment of TGF-Mediated Diseases*
Tim Lyden	UW-River Falls	$27,344	*Development of Artificial Tissues for Potential Vaccine Production and Pharmaceutical Compound Testing Methods*
Mike Zach	UW-Stevens Point	$48,363	*Going from a Scientific Curiosity to a Commercializable Process with Wide Ranging Applications*
Ryo Amano	UW-Milwaukee	$48,221	*Study of a Porous-Based Radiant Burner System*
Lei Ying, et.al.	UW-Milwaukee	$37,261	*High Resolution Dynamic Contrast Enhanced Magnetic Resonance Imaging of Cancer*

Appendix E
Center for Dairy Profitability Research and Outreach Grants
Awarded from External Sources

Investigator	Funding Source	Amount	Title
Joy Kirkpatrick	Dairy Industry Revitalization Grant- Herb Kohl and David Obey	$60,000	*Enhancing Facilities of Retiring Farmers project*
Joy Kirkpatrick	Dairy Industry Revitalization Grant- Herb Kohl and David Obey	$15,000	*Farming Together workshops*
Joy Kirkpatrick Jenny Vanderlin	USDA RMA Grant	$10,000	*Heart of the Farm- The Next Level*
Jenny Vanderlin	USDA RMA Grant	$9,562	*Improved Risk Management via Accrual Accounting.*
Jenny Vanderlin, Gregg Hadley, Carl Duley (PI), Bob Cropp, Randy Knapp, Jon Zander	Dairy Industry Revitalization Grant- Herb Kohl and David Obey	$15,000	*Improving Capacities of Dairy Managers through Assessment and Training (aka Management Assessment Center)*
Jenny Vanderlin, Joy Kirkpatrick	North Central Region Risk Management Education Center University of Nebraska- Lincoln	$25,000	*Heart of the Farm- Greenfields*
Jenny Vanderlin	North Central Region Risk Management Education Center University of Nebraska- Lincoln	$36,628	*Success for Small Beginning Dairy Farmers*
David Kammel	Dairy Industry Revitalization Grant- Herb Kohl and David Obey	$2,168	*Regional Dairy Modernization Meetings*
David Kammel	Dairy Industry Revitalization Grant- Herb Kohl and David Obey	$32,650	*Dairy Modernization Planning Team Support Person*
David Kammel	Dairy Industry Revitalization Grant- Herb Kohl and David Obey	$24,479	*Dairy Modernization Planning Team Support*
Jenny Vanderlin	North Central Region Risk Management Education Center University of Nebraska- Lincoln	$43,565	*Annie's Project for Value Added and Beginning Wisconsin Farm Women*
Jenny Vanderlin	North Central Region Risk Management Education Center University of Nebraska- Lincoln	$16,878	*Quickbooks: Beyond the First Step*
Jenny Vanderlin, Randy Knapp, Nate Splett	Dairy Industry Revitalization Grant- Herb Kohl and David Obey	$8,096	*Assessing the Future Educational Curricula Needs for Wisconsin Large Dairy Farms*
Total External Funding		**$299,026**	